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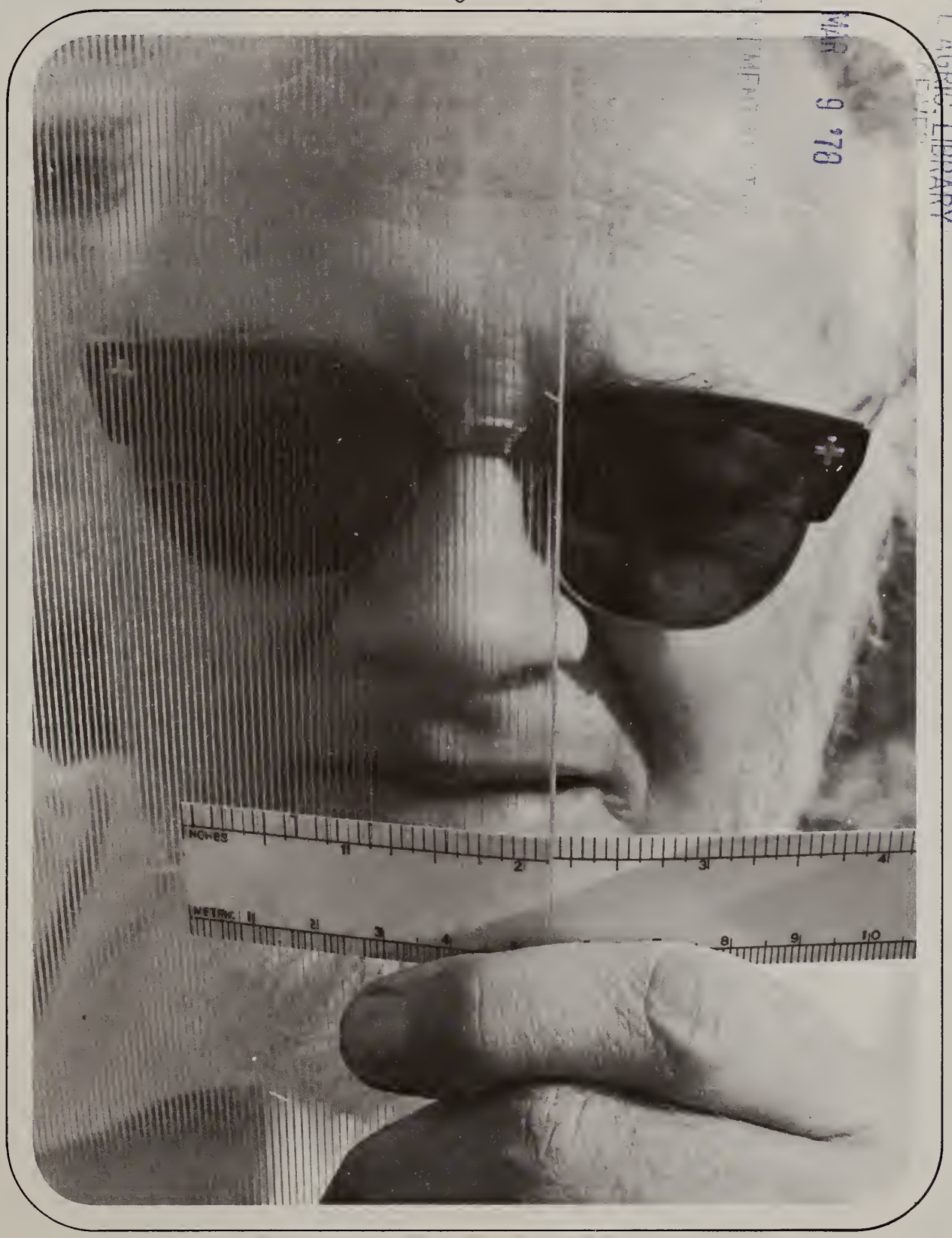

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Sun Power

The night has a thousand eyes,
And the day but one;
Yet the light of the bright world dies
With the dying sun.
—Francis William Bourdillon.

As the icy winds of February caress the frozen soil, the luminance and warmth of the sun diminish. On these wintry days, the sun seems to double-time across the sky.

We tend to take this small-sized star among billions for granted. The center of our solar system is about 93 million miles away. The sun's brilliance, traveling at the speed of light, takes a little over 8 minutes to reach us.

As the ultimate source of all forms of energy on Earth, the sun's importance to humans can hardly be exaggerated. If the sun were to shine only a little brighter or a little dimmer, life forms on this planet would vanish. Our climate, our fuel, our food—all originate in the power of sunlight.

Sunshine can be converted directly into heat. It has several advantages over more conventional energy sources—it is clean, nonpolluting, and virtually inexhaustible. It, like the wind, however, can be capricious. Elusive sunbeams are difficult to catch and control. And, we can't depend on the sun to shine every day.

Major drawbacks to sunpower are high investment costs and inadequate equipment. The investment required to have America 40 percent solar-powered by the year 2000 has been termed "staggering."

SEA scientists, however, are now working with a plastic solar lens (see p. 8) that may help drive down the cost of sunpower. Other SEA scientists, in cooperation with various State agricultural experiment stations, are experimentally collecting and using solar energy to dry numerous agricultural crops.

SEA scientists are also testing various ways of using sunpower—to heat and cool milking parlors, to heat poultry and swine houses, and to dry poultry manure. Other scientists are heating and cooling greenhouses and rural homes with solar energy.

We must urgently turn to the sun as a potentially prime source of energy for agriculture. We must find the right technology to put the sun's tremendous energy to work for us.

Farmers have always had to rely on the sun—"making hay" in its light. Today, we must all look to the energy falling from the sky for tomorrow's power.—*M.M.M.*

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COVER: SEA scientists work with solar lenses (1174X1534–19). Article begins on page 8.

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U.S. Department of Agriculture

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Pyramids Trap Face Flies

FACE FLIES, a major pest of cattle, can be effectively controlled by catching them on traps shaped like pyramids.

Face flies congregate on the faces of dairy and beef cattle. These pests transmit an eyeworm and pinkeye, and by annoying cattle cause them to cease grazing and gather in groups. At present, there is no economically effective control measure for face flies.

The new traps, developed by SEA entomologist Lawrence Pickens and SEA animal scientist Richard Miller, have reduced face fly numbers by as

Face flies harass a dairy cow (0877X1122–9).

much as 70 percent in experimental pastures at the Beltsville Agricultural Research Center.

The traps are constructed of 20- by 30-inch plywood triangles joined at the top to form a pyramid. The pyramids are painted with a white latex paint and then covered with clear plastic. A sticky substance is spread on the plastic. Different shapes, sizes, and colors of traps have been tried, but the white pyramid trap reflects light at an angle that attracts the most flies.

The traps are attached to steel fence posts 3 feet off the ground, the height at which most face flies are found. Various heights for the traps are being tried; when placed closer to the ground, the traps also attract stable flies.

The scientists are investigating methods of treating the traps with pesticides that would kill the flies when they land. Pesticides would eliminate the need to change the plastic every few days when it becomes covered with flies.

The traps catch the most flies near feeding and watering troughs, and when placed in areas near where cattle rest. So far tests have shown about one trap per seven head of cattle to be the most effective. However, Mr. Pickens and Dr. Miller are trying to determine if this number is adequate for all situations.

Plans are being made to test the traps on commercial farms and to compare numbers of face flies on these farms with numbers of flies on untrapped farms.

Mr. Pickens and Dr. Miller are at the Chemical and Biophysical Control Laboratory, Building 177 A, BARC–East, Beltsville, MD 20705.—M.E.N.

Above: Cows drinking undisturbed by face flies bear testimony to the effectiveness of the new pyramid-shaped traps (0877X1121–25A).
***Above right:** Mr. Pickens strips fly-laden plastic from pyramid traps (rear). After covering the traps with fresh plastic, biological laboratory technician James J. Grasela paints them with a sticky substance to catch still more flies (0877X1119–2A).*
***Right:** Green-tinted face flies are released by Dr. Miller in dispersal pattern studies. Numbers of tinted flies caught on pyramid traps aid researchers in determining their migratory habits (0877X1119–10A).*

a mixed blessing...

Broiler Litter Fertilized Fescue

THE INCREASING USE of broiler litter to fertilize fescue pastures in the Southeast creates a mixture of blessings and problems.

Among the blessings has been the development of lush pastures on land that once was badly eroded or otherwise marginal or nonproductive. Moreover, such use makes a resource out of litter, which otherwise may be a waste, or even a health hazard.

Among the problems have been questions of animal health: Grass tetany, fat necrosis, parasitism, and nitrate toxicity.

To find answers to these questions a team of SEA and University of Georgia scientists conducted a 5-year cooperative study at the Southern Piedmont Conservation Research Laboratory (SPCRL) in Watkinsville, Ga. The study included cow-calf grazing of pastures fertilized with broiler litter and with inorganic or chemical fertilizers at high, moderate, and low rates.

As a result of the long-term study the scientists recommend that broiler litter be used on fescue pastures at a rate of 9 metric tons or less per acre per year. At this rate of application, problems will be minimized and will be similar to those which might occur if the fescue were fertilized with a comparable amount of nutrients from inorganic fertilizers. They also recommend that the litter be divided into two or more applications.

Grass tetany is a disease caused by insufficient intake of available magnesium by cows on a day-by-day basis during cool seasons, while the cow grazes fescue and other cool-season grasses such as rye and wheat.

The scientists found that the higher the rate of fertilization, the higher the incidence of tetany among cows not given a magnesium supplement. However, there were no cases of tetany among cows given a daily supplement of magnesium regardless of the rate of fertilization, according to SEA animal physiologist Dr. John A. Stuedemann of the SPCRL.

Fat necrosis is an entirely different kind of problem, Dr. Stuedemann said. It is the development of hard masses of fat within the animal's body. But although scientists don't yet know what causes the hard fatty deposits, which eventually are fatal to the animal, they say they cannot be attributed to poultry litter fertilization because fat necrosis occurs when high levels of nitrogen are used regardless of the source.

Dr. Stuedemann says that fat necrosis has **never** been found in cattle less than 2 years old, which would indicate that even pastures heavily fertilized with poultry litter could be used for growing weaned calves as long as proper care is taken to prevent nitrate toxicity.

The study showed there was no difference and that there were generally very low levels of parasitism by nematodes and coccidia oocysts in cows grazing the different pastures, according to SEA microbiologist Dr. Honorico Ciordia of the Cattle Parasites Research Laboratory. However, he said, calves were more parasitized than cows. The number of nematode eggs recovered from the calves increase as the level of fertilization decreased. In general, he said, the study showed that calves grazing the fescue fertilized by broiler litter had the lowest egg counts. This, Dr. Ciordia said, could probably be attributed to the fact that the more heavily fertilized pastures had a more lush growth, which reduced the need for the animals to eat grass close to the ground.

The average number of coccidia oocysts from the three pastures showed no clear-cut differences among pastures, and no detectable health problems were associated with the coccidia.

Dr. Stanley R. Wilkinson, SEA soil scientist at the SPCRL, reported that plant levels of nitrate nitrogen reached as high as 3,300 parts per million on the fescue fertilized with broiler litter. However, he said, there was no direct evidence that the nitrate nitrogen level had any effect on animal health and no nitrate toxicity was observed.

Dr. John A. Stuedemann and Dr. Stanley R. Wilkinson are at the Southern Piedmont Conservation Research Laboratory, Highway 53, P.O. Box 555, Watkinsville, GA 30677. Dr. Honorico Ciordia is with the National Animal Parasite Laboratory, Experiment, GA 30313.—*V.R.B.*

Finsheep in Breeding System Boosts Lamb Production

A Finn-cross ewe and her triplets cross a pasture at the U.S. Meat Animal Research Center at Clay Center, Nebr. (0676X680–16A).

EWE COSTS in producing a pound of lamb can be lowered 20 to 25 percent with half-Finnsheep rather than half-Rambouillet ewes in an optimal crossbreeding system.

The commercial half-Finnsheep ewes would be crosses with Dorset, Suffolk, Targhee, or Rambouillet, and would be mated to superior meat-breed sires.

This breeding system maximizes the gains from both breed superiority and the hybrid vigor of crossbred ewes and lambs, including multiple births, accelerated frequency of lambing, and faster growth to heavier market weight.

SEA geneticist Gordon E. Dickerson cautions that the genetic potential will be fully utilized only with better environmental protection, nutrition, health care, marketing, and processing systems.

Dr. Dickerson statistically summarized performance evaluations of Finncross ewes at the U.S. Meat Animal Research Center, Clay Center, Nebr.; the U.S. Sheep Experiment Station, Dubois, Idaho; the Minnesota, Oklahoma, and California Agricultural Experiment Stations; and European research centers.

Half-Finnsheep ewe lambs begin lambing at 1 year and produce more twins and triplets than half-Rambouillet crossbreds—adding at least 50 more live lambs per 100 ewes each year. The lambs average 5 to 6 pounds lighter at 10 weeks, but are only slightly below lambs from half-Rambouillet ewes in livability, postweaning gain, and carcass yield and grade at the same carcass weight.

Half-Finn crossbred ewes have a clear advantage over quarter-Finn ewes when nutrition and lambing husbandry are reasonably adequate, Dr. Dickerson says. Quarter-Finn ewes may raise nearly as many lambs and have a longer productive life under poor range conditions and with severe climatic exposure at lambing.

Using quarter-Finn crossbred ewes can add about 20 lambs born alive per 100 ewes to the number produced by domestic breeds or crosses.

Gains from breed differences and hy-

brid vigor in crossbreeding are greatest, the studies show, when first-cross half-Finnsheep ewes from superior maternal breeds are mated with sires transmitting superior growth and carcass characteristics to their market lambs.

If first-cross half-Finn ewes cannot be produced or purchased economically, Dr. Dickerson suggests an alternative: Use a rotation of half-Finnsheep rams on enough of the younger half-Finn ewes to provide necessary replacements. He says this procedure should maintain the prolificacy of half-Finn ewes at minimum cost without reducing hybrid vigor of the market lambs by superior meat-breed sires.

Comparisons of three sire breeds indicate performance differences depending on rate of lamb mortality, Dr. Dickerson reports.

When lamb mortality is intermediate (10 to 20 percent), differences among Suffolk, Hampshire, and Oxford sire breeds would be small for total pounds of lamb marketed at 22 or 31 weeks of age per 100 lambs born. When mortality is low, superior lamb growth favors Suffolk crosses, and superior livability favors Oxford crosses when mortality is more than 25 percent. Hampshires are intermediate in low- or high-mortality situations.

European sheep breeds other than Finnsheep have performance characteristics useful in further improvement of market lamb production in this country, Dr. Dickerson says. He cites Texel, used for meat lamb production in the Netherlands and adjoining countries, and Romanov, an eastern European breed similar to Finnsheep in early sexual maturity and prolificacy.

Quarantine regulations prohibiting importation from countries where foot-and-mouth disease exists, as well as post-importation quarantine for the disease scrapie, have prevented introduction of these breeds to this country.

Dr. Gordon E. Dickerson is at 225 Marvel Baker Hall, University of Nebraska, East Campus, Lincoln, NE 68583.—*W.W.M.*

Enzyme Exposed in Rice Weed Control

Weed control in crop production is difficult enough because of the prolific nature and long dormancy of certain weed seeds, but when weeds which are closely related to the crop are involved, weed control becomes an even more formidable task. Weeds of the same plant family or species as commercial plant varieties present a peculiar weed control problem when these plants exist together.

Research conducted by Robert E. Hoagland in Stoneville, Miss., reveals the reason that red rice, a weed which costs rice growers millions annually, is able to resist control with the herbicide propanil. Botanically, red rice is the same species as commercial rice varieties (*Oryza sativa L.*) and is resistant to control because it possesses an enzyme, aryl acylamidase, which metabolizes and detoxifies propanil. Commercial rice varieties have the same enzyme, otherwise they would be killed by this herbicide which effectively controls several other rice weeds. The presence of this enzyme in red rice is one reason for the persistence of this weed in rice fields.

In isolating, partially purifying, and characterizing the enzyme, researchers have shed some light on the dilemma faced by farmers who must combat weeds which are close relatives of the crop that is cultivated. Some tools that farmers may use in their control of such weeds are the use of certified seed, proper tillage practices, and crop rotation. In crop rotation, rice may be rotated with soybeans in alternate seasons and a soybean weed herbicide can be used to destroy red rice seedlings.

The nature of the farmer's plight with respect to closely related weeds is not limited to rice production. Cotton growers are also faced with weeds which belong to the same family as cotton, and these weeds are increasing because they have herbicide-resistant mechanisms that are similiar to those of cotton plants. A great challenge for scientists exists in the determination of herbicide resistance and selectivity mechanisms in closely related plants so that more effective weed control can be achieved.

Dr. Robert E. Hoagland's address is: U.S. Delta States Agriculture Research Center, P.O. Box 225, Stoneville, MS 38776.—*E.L.*

SOMETHING NEW UNDER THE SUN . . .

Solar Focusing Plastic Panels

Thermocouples have been installed throughout the solar-lens greenhouse. Here, chemist Glen F. Bailey monitors temperature rise of fluid flowing through heat-resistant glass tubes at the line of focus. In this experimental use of plastic fresnel lenses, surfaces have been curved on frames that can be pivoted to take greater advantage of the sun's rays as it moves across the sky. A target tube can be seen directly above Mr. Bailey's head (1177X1535–27).

Utilization of solar energy may not be, as many people believe, "light-years away." Until now, major drawbacks of solar power have been high investment costs and inadequate equipment compared to that for burning fossil fuels.

Newly developed plastic lenses concentrate sunlight before it is absorbed and converted into heat energy. In one trial run, these inexpensive concentrating lenses created temperatures as high as 245° C (473° F), sufficient for use in air conditioners, industrial and crop drying, and steam generation of electricity.

Present techniques to utilize solar energy by flat plates, which function much like hot tin roofs with pipes inside them, can produce temperatures high enough for only refrigeration and for boiling water, but not most industrial uses. This technique is expensive mainly because it requires coatings and insulating vacuum jackets over the whole area intercepting sunlight.

The new lenses can concentrate light more than 10 times so that less than one-tenth of the area must be coated and encased in the expensive insulating jackets. In addition, the lenses generate higher temperatures.

The rectangular lenses can be mass produced by a process similar to that used in making ordinary plastic kitchen wraps. However, the lenses are thicker and are imprinted with a special grooved pattern to concentrate the sun's energy. Production costs are estimated to be less than 25 cents per square foot.

SEA scientists designed these particular lenses to have about 1,000 grooves, much like a record disc, only straight rather than circular. These grooves actually form small prisms of varying angles, and each prism bends the light to converge on a common line or focus. The angles of the prisms range from about 0° at the center to 45° on the sides. Each lens is 36 inches wide; the lenses vary in length up to 8 feet.

When the lens is bent to form an arc of 24° of a circle having a 24-inch radius, light is focused on a line five-eighths of an inch wide, 30 inches below. This light, when focused on a black, heat-absorbing pipe, heated water inside the pipe.

Scientists at SEA's Western Regional Research Center encased the pipe in a glass tube containing a vacuum. This glass tube allows nearly all the sun's energy to enter and heat the metal pipe, but acts as an insulator to prevent heat from escaping from the system.

"We could have a lens 3 by 8 feet weighing only about 2 pounds by making the lens less than one-fiftieth of an inch thick. Placing a lens in an aluminum extruded frame would bring its total weight to slightly over 12 pounds. This equipment would require very little electrical or manual energy to track or follow the sun as it moves across the sky," says chemist Shlomo Rosenbaum at the center.

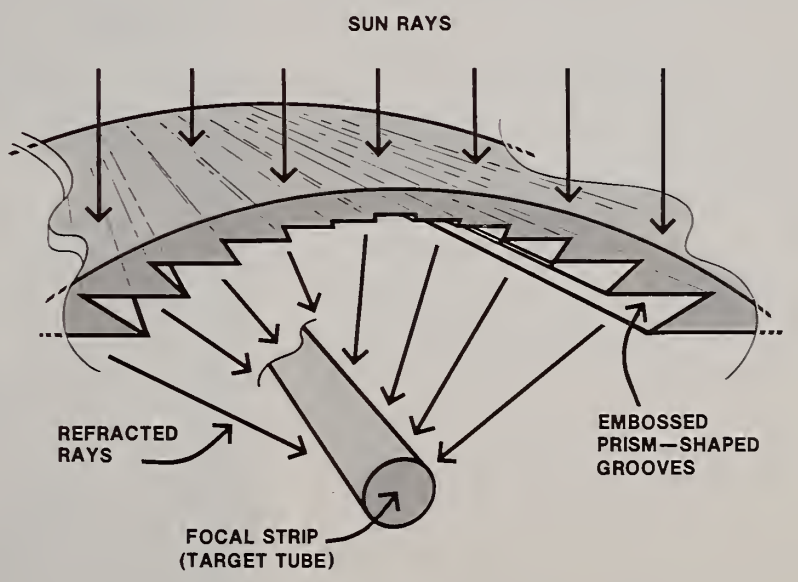
"These lenses could be manufactured in any length or width to allow easy

Shedding Some Light on the Fresnel-Style Solar Lens

The fresnel-style lens described in this article provides a highly efficient and inexpensive way to focus large areas of sunlight on a small target. Its potential for solar energy application is enormous.

The lens is made from a clear plastic sheet by embossing a series of grooves—each only a fraction of a millimeter deep. Each groove creates a long, thin prism. Sunlight hitting the grooves is bent according to the pitch of the individual prism. Successive grooves gradually increase in steepness as they approach the outer edges of the lens. Because of these special characteristics, sunlight bends and converges on one focal point—actually a "focal strip" that runs parallel to the grooves. In effect, the plastic sheet becomes a series of prisms that together function as one large solar-focusing device.

Large fresnel-style lenses can be economically mass produced using an extrusion and embossing process. Several basic sizes or shapes can be produced—flat or curved—depending on architectural requirements. All would be able to concentrate sunlight at a cost far below previous estimates for focusing devices.



Above: To test efficiency of the new plastic lenses, Dr. Rosenbaum (left) and Mr. Bailey measure the intensity of sunlight which will be compared with energy collection data from the greenhouse equipped with solar lens in background (1177X1534–27).

***Right:** Horticulturist David Rudé (right) of the Central Coast Counties Development Corp. describes to Dr. Rosenbaum details of the architectural framework for solar collectors in the experimental greenhouse he designed and constructed. Mr. Rudé says knowledge gained from this experiment will permit interior components of a newer model solar-lens greenhouse to be made of substantially lighter materials (1177X1533–20).*

installation in existing buildings or to conform to future construction requirements," says Rosenbaum.

Installed in buildings running east to west, the lenses need be moved only about 1° once a week to keep up with the sun as it moves lower in the sky from summer to winter.

"Our lenses are still in an experimental stage, and they focus only 30 percent of the available sunlight. But that's still enough heat to boil water. With slight modifications, we can produce lenses that use at least 75 percent of the light. This would make them efficient for most industrial production," says chemist Allen G. Pittman. "Also, I would select a tougher material like polycarbonate plastic instead of the flexible acrylic plastic we used the first time."

"I believe these lenses provide a very promising basis for a method to collect energy for most industrial uses," says chemist Glen F. Bailey. "When fossil fuels are burned, their temperatures often reach 2,000° C (approximately 3,600° F). This is a waste of our scarce fuel resources—most space heating and industrial uses require only 200° to 300° C (390° to 575° F). Engineering studies show that theoretically our system could provide temperatures in excess of 500° C (approximately 950° F). Thus we could save our fossil fuels for processes which require high temperatures, like steel manufacturing."

Researchers at the center have loaned the lenses to the State of California's Department of Housing and Community Development for incorporation into a new greenhouse recently constructed near Watsonville, Calif. The greenhouse has a base approximately 14 by 20 feet. Its roof, angled at 45 degrees to intercept more sunlight than a flat roof, rises 17½ feet on the highest side. Since the lenses are clear, sunlight passes through to the plants below. Although the lenses are now used only for heating the greenhouse, part of the collected solar energy could be converted to electrical power.

Meanwhile the center is studying the feasibility of providing most of the energy requirements for the day shift of a textile mill. This will be at a cost competitive with energy from fossil fuels.

Dr. Allen G. Pittman is with the Western Regional Research Center, 800 Buchanan Street, Berkeley, CA 94710.—*D.H.S.*

Collecting animal wastes from a lagoon. Bubbles are methane gas created by microorganisms. Effluent is pumped to adjacent croplands and distributed through an irrigation pipe. (Courtesy Soil Conservation Service.) (PN–4155.)

Harvesting Lagoon Biomass

THE BIOMASS OF holding ponds has potential as a new source of feed, fertilizer, and fuel. Biomass is the sum total of all living organisms—plant, animal, bacteria, and other microorganisms. In agricultural language, holding ponds are called lagoons, which are widely used for handling livestock wastes.

When properly managed, lagoons work on a beneficial cycle of oxygen and carbon dioxide. Bacteria break down the sewage into nutrients which algae consume along with carbon dioxide. The algae, in turn, produce oxygen for the bacteria.

Technical and economic problems of harvesting lagoon biomass have been a major obstacle in large-scale research to determine the value of algae for animal feed and for fertilizer.

An SEA-sponsored Indian project has now developed a harvesting technique that is simple and inexpensive. The biomass can be flocculated or formed into clumps. These clumps or floc formations then sink, trapping most of the biomass.

Under the proper conditions and after a certain amount of time, the entire mass will rise and float as a mat, permitting easy removal. Of the six flocculant agents tested, the Indian scientists found commercial alum to be the best. It is least expensive and effective at a wide pH range (from 6.0 to 9.5).

A spinoff of the Indian study is that municipal as well as rural lagoons can be easily cleaned before there is a surface buildup of algal bloom. This buildup interferes with photosynthesis and creates eutrophic conditions when one species of algae dies and sinks to the bottom, making room for another more dominant species. The harvesting technique developed by the Indians can prolong the life of a lagoon as a sewage disposal unit, make it more efficient, and reduce massive sludge buildup on the bottom.

If further research through chemical analysis and feeding trials bears out the potential of biomass harvest for soil amendment and livestock feed, the results of this project will be of considerable value to agriculture.

The lagoon biomass might also be used for methane gas production, adding another source of fuel to cope with energy problems.

The Indian project, conducted under Public Law 480, was directed by Dr. G. C. Mitra and Dr. V. P. Singh at the National Botanic Gardens, Lucknow, India. Agricultural engineer Harry J. Eby, formerly of the Beltsville Agricultural Research Center (now retired), was the SEA-cooperating scientist for this project.—*M.C.G.*

The detoxification mechanism for a herbicide called atrazine is not present in many plants, such as these oats. The sample of oats in the foreground was treated with atrazine, which eventually killed the plants (777B922–4A).

Selective Action of Herbicides

DISCOVERY OF A previously unknown way plants detoxify foreign chemicals explains how at least eight herbicides kill some plants in concentrations that do not injure others.

What is known as the mercapturic acid pathway of metabolism is a way animals, including humans, detoxify and excrete many foreign chemicals. A similar detoxification process also functions in plants.

SEA plant physiologist Richard H. Shimabukuro and chemists Gerald L. Lamoureux and D. Stuart Frear first demonstrated that a mercapturic acid-like pathway is responsible for the breakdown of the herbicide atrazine in sorghum, a crop resistant to the herbicide in concentrations ordinarily used in weed control.

These scientists, with Harley R. Swanson, Lester E. Stafford, and Wendy C. Walsh at the Metabolism and Radiation Research Laboratory, Fargo, N. Dak., later found this pathway also functions in other crops and with such herbicides as propazine, cyprazine, CDAA, propachlor, fluorodifen, and barban. An understanding of how the chemical structure of a herbicide is changed in plants is essential in evaluating environmental affects of its use, the scientists say.

The first step in the detoxification process in animals or plants is a chemical binding of the foreign compound with glutathione, a naturally occurring peptide composed of the amino acids glycine, glutamic acid, and cysteine. The scientists call this binding conjugation.

In animals, first glutamic acid and then glycine are removed in the mercapturic acid pathway, leaving the foreign compound bonded to cysteine. The cysteine-bonded foreign chemical is then further modified to a mercapturic acid and excreted in the urine.

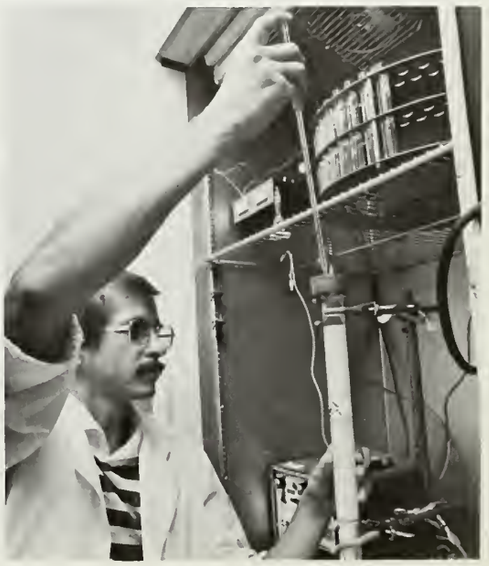
In plants, a number of herbicides react with glutathione in a similar manner, the Fargo scientists found. Plants, however, break down the glutathione conjugates by removing the two amino acids in reverse order—glycine first, then glutamic acid.

In addition, plants do not convert herbicides or other foreign compounds to mercapturic acid. Instead, the final products of metabolism seem to vary with the plant species and the nature of the foreign compound. And those final products of metabolism often remain within the plant in an apparently benign form for the remainder of the plant's life, since plants lack the well-developed excretory system of animals.

Discovery of the glutathione conjugation pathway in plants has helped scientists at other laboratories better understand how some crop protectants, a new class of agricultural chemicals, function in plants. Certain protectants intensify glutathione conjugation, thus permitting application rates that otherwise would injure the crop. By better weed control and reduced crop injury, use of crop protectants is adding an estimated $1 million to the value of the corn crop annually.

Glutathione conjugation produces dramatic changes in the herbicide's

Dr. Lamoureux pours "column eluant" (a separated component of a chemical mixture processed through column chromatography) containing purified compounds extracted from sorghum. After the compounds are totally isolated, their molecular structure will be determined through physical and chemical analyses (777B923–6).



properties that destroy its toxicity, the scientists explain. Conjugation changes the herbicide from a small, chemically neutral molecule with limited water solubility to a much larger, water-soluble molecule capable of reacting with acids and bases.

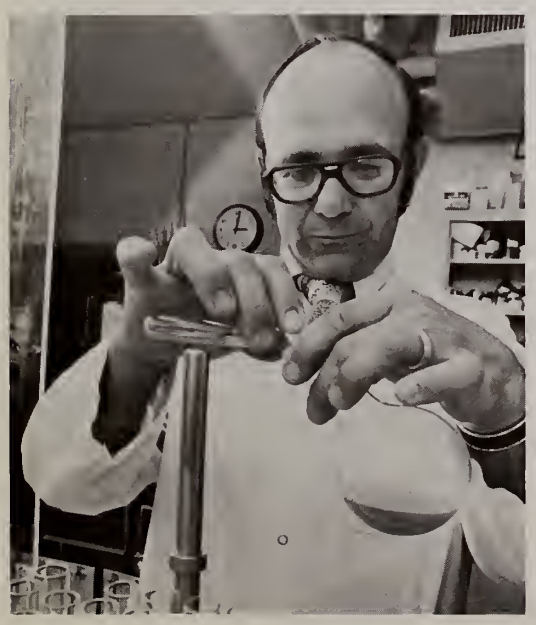
The initial conjugation reaction with glutathione, the key step in detoxification, is generally initiated by a highly specific natural enzyme (one that triggers the conjugation reaction with a certain class of herbicides). The Fargo scientists have identified two such enzymes. One catalyzes the reaction of glutathione with fluorodifen, and the other enzyme triggers the reaction with atrazine and other closely related herbicides. Presence or absence of these enzymes in tissues of different plant species is genetically controlled.

Many herbicides used today are toxic to plants because they interfere with such vital processes as photosynthesis or cell division, the researchers explain. So herbicides generally have some degree of toxicity to all plants. Herbicides become selective—capable of killing or injuring some species but not injuring others—when used at rates allowing the herbicide to reach toxic levels in some species but not in others.

Atrazine stops photosynthesis in both resistant and susceptible plants, the scientists found. In resistant plants, photosynthesis is stopped temporarily until the atrazine is detoxified by glutathione conjugation, then the photosynthesis returns to normal. Susceptible species, unable to detoxify atrazine, do not recover their photosynthetic ability and subsequently die.

Dr. Richard H. Shimabukuro, Dr. Gerald L. Lamoureux, and Dr. D. Stuart Frear are at the Metabolism and Radiation Research Laboratory, P.O. Box 5674, Fargo, ND 58102.—*W.W.M.*

Plant physiologist Harley Swanson loads a gel filtration column with a centrifuge homoginate containing the glutathione–S transferase enzyme. Once the enzyme is isolated, scientists will be able to duplicate in a test tube the same herbicide detoxification mechanism that occurs naturally in certain plants (777B923–34).



Smut Threatens Mainland Sugarcane

SMUT, A DISEASE of sugarcane caused by the fungus *Ustilago scitaminea*, is now in the tropical storm tract about 600 miles from the U.S. mainland. Wind-disseminated, it poses a threat to the sugarcane-growing States of Florida, Louisiana, and Texas.

Jamaican scientists, under a USDA cooperative agreement with the Sugar Industry Research Institute, will determine the varietal resistance to the smut of at least 600 commercial and experimental sugarcane clones supplied by SEA.

"Because of Jamaican quarantine requirements, testing will begin about September 1978," says plant pathologist Jack L. Dean at the U.S. Sugarcane Field Station.

The sugarcane smut, long present in Asia and Africa, first appeared as a serious threat to the U.S. when it was found on the northern coast of South America—Guyana—and then it invaded Trinidad and Martinique in 1974. The threat became acute when it was found in Jamaica in 1976.

U.S. scientists have no data on the reaction of mainland clones to the Jamaican race of smut which is most likely to be introduced, but about 65 percent of the mainland acreage is in clones highly susceptible to the Rhodesian race of smut.

The effect of the disease on the cane depends upon the degree of resistance of the cane variety, and the time at which infection occurs.

"Sugarcane smut has caused serious economic loss in some countries and little damage in others. In all cases, the disease has been brought under control in a few years by means of resistant varieties. It is important to determine the degree of resistance of commercial varieties and canes used as parents in breeding programs as early as possible," says Dr. Dean.

The smut is characterized by a slender, whip-like appendage which emerges from the growing point of the plant. The black color is caused by a layer of dark fungus spores that can be rubbed off in soot-like masses. Infection occurs through buds, usually when they are germinating.

Primary shoot infection of a very susceptible variety may result in a stunted, grassy-appearing stool with many smut whips and no millable stalks. A stool of a more resistant variety may show a single smut whip on a nearly normal millable stalk.

Dr. Jack L. Dean is with the U.S. Sugarcane Field Station, Star Route, Box 8, Canal Point, FL 33438.—*P.L.G.*

Weed Control on Roadbanks

THE PREVENTION OF soil erosion on roadbanks is dependent upon the establishment of good ground cover along the banks. Too often weeds crowd out native grasses on roadbanks and make highways unsightly.

Researchers evaluated herbicides that provided acceptable control of Russian thistle, summercypress, and other undesirable annual weeds and yet were of low toxicity to established desirable grasses and crops and ornamentals growing near the right of way.

The experiments revealed that bromoxynil at recommended rates provides excellent weed control on newly seeded roadsides and on established stands of grass where annual broadleafed weeds are a problem. It is relatively nontoxic to desirable grasses in all stages of growth. Simazine gave excellent preemergence weed control and was of low toxicity to established warm season grasses. Chlorflurenol, a plant growth suppressant, did not kill Russian thistle or summercypress. Both bromacil and karbutilate were effective for weed control but require further evaluation to determine their long-term environmental impact.

Although bromoxynil is now used by the New Mexico State Highway Department, additional research is desirable to assess its safety and effectiveness in a variety of soils, locations, and climates in New Mexico and elsewhere in the Southwest.

Russian thistle and summercypress (Kochia) have been the worst weed problems in roadside seedings of native grasses in New Mexico. Mowing is recommended the first year of seeding for the control of Russian thistle when it is the predominant weed. The mowed thistles provide some cover for the soil and shade the new grass seedlings without undue competition. Even when mowed, summercypress competes for water and nutrients with desired grasses. A dense stand can completely crowd out grass seedlings. On steep slopes and areas that cannot be mowed, Russian thistle and summercypress even compete with established grasses during the second and third season after planting. Mowing during the first season of growth is often detrimental to desired grasses which need every bit of growth to establish strong roots.

The research was conducted by SEA researchers Paul C. Quimby of the Southern Weed Science Laboratory, P.O. Box 225, Stoneville, MS 38776 and Robert L. McDonald of the Western Cotton Research Laboratory, 4135 E. Broadway Road, Phoenix, AZ 85040, working cooperatively with R. G. Lohmiller of the Soil Conservation Service, Bozeman, MT, and R. L. Brammer of the New Mexico State Highway Dept., Sante Fe, NM.—*E.L.*

Detecting Ozone Damage

SPACE AGE technology has enabled researchers to surmount the limitations of tedious field inspections to survey crop damage. Crop damage caused by ozone may one day be detected from the air by sensors attached to aircraft and spacecraft.

Ozone (O_3), an oxygen derivative that is normally a faintly blue irritating gas, may reach a concentration of 70 parts per hundred million (pphm) in the Los Angeles basin, and is probably the most important air pollutant affecting plant growth, development, and reproduction in the United States. Ozone causes as much as 90 percent of pollution injury to vegetation, some of which is invisible and can cause yield decreases. It can also harm people, fabrics, and rubber.

Ozone is formed by a photochemically induced reaction between hydrocarbons and nitrogen oxides of automobile exhaust gases. The nitrogen oxides produce atomic oxygen (O) which combines with oxygen in the air (O_2) to form ozone (O_3). Some ozone may also descend to the earth's surface from the stratosphere, or it can be formed by electrical storms and electrical discharges.

SEA researchers working with Dr. Harold Gausman and Dr. Claude E. Thomas in Weslaco, Tex., studied ozone damage by recording reflectance and photographic responses of cantaloupe leaves to determine the best wavelengths to detect ozone damage. The sci-

entists sought to determine if the damage could be detected before its was visible to the eye.

Cantaloupe leaves with artificially induced ozone damage were detected by infrared photography 16 hours before the damage could be seen with the naked eye. Researchers hope to use this knowledge to develop remote sensing techniques to routinely detect sources of pollution, and identify ozone-damaged and pollution-resistant crops.

Dr. Harold Gausman's address is: Soil and Water Conservation Research Laboratory, P.O. Box 267, Weslaco, TX 78596.—*E.L.*

Insect Resistant Soybeans

SEVERAL SOYBEAN lines that may be resistant to most leaf-feeding insects are adapted only to southern States, but the lines can be used in breeding programs to impart resistance to earlier maturing varieties for the Midwest.

At Stoneville, Miss., ARS scientists have conducted laboratory studies that showed the plant introductions, PI171-451, PI227687, and PI229358, have strong antibiotic effects on immature stages of bollworm and tobacco budworm (AGR. RES., July 1977, p. 3). Other scientists have reported that the same plant introductions resist leaf feeding by the Mexican bean beetle and the striped cucumber beetle.

Now, SEA agronomist Virgil D. Luedders and SEA entomologist Willard A. Dickerson, Columbia, Mo., have found that these soybean plant introductions resist leaf feeding by young cabbage looper larvae. In field experiments, the scientists placed laboratory-reared cabbage looper larvae on the plant introductions and the popular varieties, Amsoy 71 and Beeson.

Crosses between the plant introductions and popular varieties also were exposed to measured infestations of the insect larvae. Some crosses appeared to be as resistant to leaf feeding as their resistant parents. The genes for resistance did not appear to be closely linked with a gene for late maturity.

Dr. Virgil D. Luedders' address is: USDA–SEA, 210B Waters Hall, University of Missouri, Columbia, MO 65201.—*G.B.H.*

CLS Serious in Southern Pea

CERCOSPORA LEAF SPOT (CLS) of southern pea can significantly reduce yields. In a recent SEA study losses were as much as 35.6 percent.

But since the severe defoliation that accompanies the disease generally does not occur until the plants are nearly mature, farmers have long assumed the yield-decreasing potential to be minimal. Test results indicate the disease is much more serious than previously realized.

The study conducted at the U.S. Vegetable Laboratory, Charleston, S.C., used the cultivar Colossus and the breeding line CR 17–1–34. Colossus is a well-adapted, large-seeded, brown crowder-type pea highly susceptible to CLS, and CR 17–1–34 is a cream type pea that is resistant to CLS.

Throughout the test, conditions were favorable for good plant growth and heavy CLS infection.

As the plants matured, all plants in the resistant breeding line showed a high level of CLS resistance. Foliage on the plants was, in general, green and healthy at the conclusion of the test and there was no evidence that seed yield, number of pods per plot, average number of seeds per pod, or the average weight per 100 seeds had been affected.

By contrast, all plants of the susceptible cultivar Colossus that were not protected by fungicides developed abundant lesions, were extensively defoliated and, in most instances, were dead at the conclusion of the test. Seed yield was down by 35.6 percent. The number of pods per plot, average number of seeds per pod, and average weight per 100 seeds were reduced by 25.4, 9.6 and 3.1 percent, respectively.

During the test, separate plots of both the resistant and the susceptible lines were treated with the fungicides benomyl and chlorothalonil. All of the plants in the fungicide-protected plots were healthy and virtually free of the disease and there was no evidence of any effect other than disease control by the fungicides on yield or yield components in either of the lines.

The study was conducted by Richard L. Fery, Dr. Philip D. Dukes, and Frank P. Cuthbert at the U.S. Vegetable Laboratory, P.O. Box 3348, Charleston, SC 29407.—*V.R.B.*

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Cocklebur Control for Soybeans

COCKLEBUR IS A thorn in the side of soybean growers from southern Canada and throughout most of the United States. It is the single most troublesome weed in soybeans in Alabama, Arkansas, Georgia, Mississippi, South Carolina, Tennessee, and Virginia and the second most troublesome in Florida, Louisiana, and Oklahoma. Soybean losses due to cocklebur in the southeastern United States alone probably exceed $90 million annually.

A 3-year (1971–1973) study by researchers Chester G. McWhorter of Stoneville, Miss. and James M. Anderson, Grand Junction, Tenn., reveals that cocklebur not only reduces soybean yields but also lowers soybean grades through increased foreign material, moisture content, and damaged kernels at harvest.

The studies were conducted in an area that had a cocklebur density of 10 to 30 thousand per acre at emergence. Soybeans were grown in 40-inch rows on clay soil in the Mississippi Delta and tilled according to practices used by soybean producers in the area. A series of different cultural practices and herbicide applications provided from 0- to 100-percent control of cockleburs. The soybeans were harvested with a combine and the 450-seed samples were graded according to USDA standards.

An analysis of the soybean harvest revealed that a minimum of 95-percent control of cocklebur was required for production of U.S. No. 1 grade soybeans; 80- to 95-percent control for No. 2 grade; and 60- to 80-percent control for No. 3 grade soybeans. The effect of cocklebur on soybean yields is even more important. Yield dropped 40 percent when no cocklebur control was attempted. Yields increased about 6.1 percent for each 10-percent increase in effectiveness of cocklebur control. Nearly complete control of cocklebur is required for maximum profits in soybean production. Each dollar invested in herbicides increased profits above specified costs about $3, a threefold return on investment.

Dr. Chester G. McWhorter is at the U.S. Delta States Agricultural Research Center, P.O. Box 225, Stoneville, MS 38776. Dr. James M. Anderson is with the Ames Plantation, Grand Junction, TN 38939.—*E.L.*

Corn Borer Infestation

WHAT LEVEL OF southwestern corn borer infestation can be tolerated without serious reductions in corn yield?

An SEA team has found that corn yields are not significantly reduced by larval feeding when plants are infested with 10 or fewer eggs per plant.

Entomologist Frank M. Davis, Plant Science Laboratory, working with agronomist Gene E. Scott and geneticist W. Paul Williams conducted a 3-year study to determine the effect of various levels of southwestern corn borer infestation on yield and height of corn. Dr. Davis artificially infested mid-whorl stage corn plants with 0, 5, 10, 15, 20, 25, 30, or 35 eggs per plant. The field tests showed that while larval feeding resulting from applications of 15 or more eggs per plant significantly reduced yield, plant height was not reduced significantly unless 30 or more eggs were applied.

Thirty southwestern corn borer eggs per plant appeared to be the optimum number for obtaining uniformly severe leaf feeding damage on susceptible corn plants. A uniform, heavy infestation is necessary in any program of selection for resistance to this insect.

Dr. Davis' address is: Plant Science Laboratory, P.O. Box 5248, Mississippi State, MS 39762.—*B.D.C.*

On January 24, 1978, three USDA agencies—the Agricultural Research Service (ARS), the Cooperative State Research Service (CSRS), and Extension Service (ES)—and the National Agricultural Library (NAL) were merged into a new organization, the Science and Education Administration (SEA).

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